



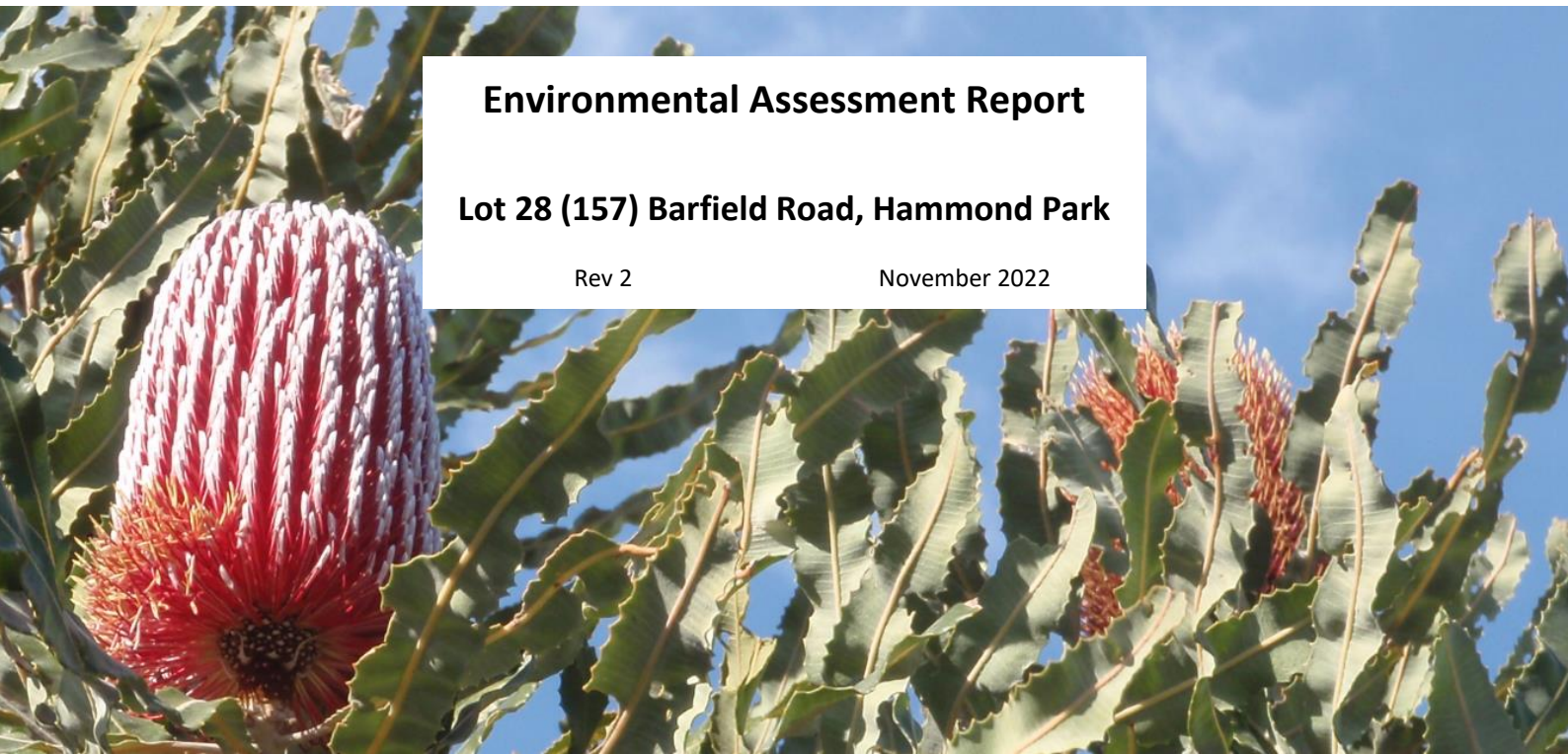
COTERRA
ENVIRONMENT

Environmental Assessment Report

Lot 28 (157) Barfield Road, Hammond Park

Rev 2

November 2022



CALIBRE | COMMITMENT | COLLABORATION

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1 Introduction

Having purchased the property in 2005, Condor Nominees is proposing to develop Lot 28 (157) Barfield Road, Hammond Park (the site) for residential purposes. The site is located within the City of Cockburn, approximately 25 kilometres (km) south of Perth Central Business District (Figure 1).

The site covers approximately 4.81 hectares (ha) and is surrounded by residential development to the north, south and west (Figure 2). A Western Power transmission line easement (2.33 ha) is located on the eastern portion of the site, between the proposed residential development and the Kwinana Freeway (Figure 2).

The site is currently unoccupied (buildings previously present have been demolished) and is approximately 80% vegetated, with some tracks and cleared areas located throughout.

In November 2021, a proposed action to clear vegetation to construct a residential development on the site was referred to the Department of Agriculture, Water and the Environment (DAWE) in accordance with the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). In December 2021, DAWE issued its decision that the proposed action is “not a controlled action”, thereby allowing the clearing and development to proceed.

1.1 Planning Context

The site is zoned ‘Urban’ under the Metropolitan Region Scheme (DoP, 1984) and is zoned partially ‘Development Zone’ and partially ‘Special Use’ under the City of Cockburn Town Planning Scheme (TPS) No. 3 (DPLH, 2002).

1.2 Land Use History

The site is currently undeveloped, although tracks/firebreaks have been historically constructed around the perimeter and throughout the site.

A brief assessment of historical aerial photography (Landgate, 2021a) is detailed below:

- **1953:** site is undeveloped. Vegetation is present on site, likely representative of remnant vegetation.
- **1965:** eastern portion of site is cleared in association with rural land uses. Western portion of site remains vegetated.
- **1970:** vegetation has regenerated through eastern portion of the site. Clearing has been undertaken to dissect the western and eastern portions of the site.
- **1974 - 1985:** the eastern portion of the site is again cleared in its entirety in association with power line infrastructure, which is visible on site. The western portion of the site remains vegetated.
- **1989:** a house and access roads (from Barfield Road) has been constructed in the western portion of the site. The eastern portion of the site remains cleared.
- **1995:** further clearing and construction has been undertaken in the western portion of the site. Some vegetation has regenerated in the eastern portion of the site. Kwinana Freeway has been constructed adjacent to the site by this point in time.
- **2000 - 2015:** no changes evident to the western or eastern portion of the site.
- **2018:** constructed buildings have been removed from the western portion of the site. The eastern portion of the site remains vegetated but partially cleared. Firebreaks are visible around the perimeter of the site.

1.3 Site Development Actions

The development of the 4.81 ha site encompasses the following:

1. 3.44 ha of vegetation clearing, comprising 2.35 ha for residential development and 1.09 ha within the Western Power easement for the excavation of sand to fill the residential development to integrate with those developments to the north and south of the site, thereby allowing the site to be gravity-sewered and drained. The proponent has, as did their neighbours, obtained Western Power's consent to excavate within their easement for the fill required for the proposed residential development
2. Subdivision of 2.48 ha of the site including construction of internal public roads, installation of services (power, gas, water, telecommunications), establishment of residential lots and public open space. A Structure Plan has been prepared for the site to facilitate development for residential purposes (Figure 3), under the City of Cockburn TPS No. 3 (DPLH, 2002)
3. The remaining 2.33 ha of the site is encumbered by a Western Power high voltage transmission line easement traversing mostly degraded vegetation. No residential lots will be located within this portion of the site, although a road reserve, earthworks and revegetation have been planned for inclusion within the easement (Figure 3).

1.4 Purpose of this Report

This report is being prepared in support of a Structure Plan, which will facilitate future residential subdivision and development of the site.

2 Key Guidance and Policies

2.1 Town Planning

2.1.1 Liveable Neighbourhoods

Liveable Neighbourhoods is the Western Australian Planning Commission's (WAPC) operational guidelines for the design and assessment of structure plans and subdivision to guide the future development of Perth and Peel and the State's regional centres (WAPC, 2015a).

Liveable Neighbourhoods is aligned to the following strategic policies:

- State Planning Strategy 2050 (WAPC, 2014)
- Perth and Peel @ 3.5 million (WAPC, 2018)
- Directions 2031 and Beyond (WAPC, 2010)
- State Planning Policy 3: Urban Growth and Settlement (WAPC, 2006).

In addition, it is supported by local planning strategies, local planning schemes, local planning policies and local development plans (WAPC, 2015a).

2.1.2 City of Cockburn Town Planning Scheme No. 3

The City of Cockburn TPS No 3 details provisions for development within the City of Cockburn. TPS No. 3 details objectives for 'Development' zones as follows:

"To provide for future residential, industrial or commercial development to be guided by a comprehensive Structure Plan prepared under the Scheme." (DPLH, 2002).

The site is with Development Area 26, which requires future development to adhere to the following scheme provisions:

- An approved Structure Plan together with all approved amendments shall be given due regard in the assessment of applications for subdivision, land use and development in accordance with clause 27(1) of the Deemed Provisions
- To provide for residential development and compatible land uses

2.1.3 City of Cockburn Local Planning Policies

The City of Cockburn has multiple local planning policies relevant to residential development, including but not limited to the following:

- Local Planning Policy (LPP) 1.12 Noise Attenuation Policy and Guidelines – provides guidance on noise management and reporting process within the City of Cockburn and requirements for different acoustic reports in support of Structure Plans and Development Applications
- LPP 5.1 Public Open Space – outlines public open space requirements in accordance with Liveable Neighbourhoods, Development Control Policy 2.3 (WAPC, 2002) and State Planning Policy 3.7 Planning for Bushfire Risk. Identifies areas that are not acceptable public open areas within a development.
- LPP 5.4 Location of High Voltage Overhead Power Lines Microwave Towers – this policy provides details on determining setback requirements from overhead power lines and residential development.
- LPP 5.11 Filling of Land – details procedure for engineering certification in relation to filled sites for subdivision and/or development.

- LPP 5.12 Retaining Walls – details development retaining wall requirements and City approvals process
- LPP 5.15 Access Street - Road Reserve & Pavement Standards – details guidance on street design and construction based on Liveable Neighbourhoods
- LPP 5.18 Subdivision and Development – Street Trees – details street tree requirements and quantities to be provided within a development, noting no specification as to species, only that they mature to a sufficient size and canopy, and provide sufficient street verge shading.

2.2 Land Use Planning

2.2.1 Guidance Statement No. 33

Environmental Protection Authority (EPA) Guidance Statement No. 33 – *Environmental Guidance for Planning and Development* (EPA, 2008) provides an overview of environmental protection processes and information, to assist land use planning and development in Western Australia. It provides specific information on (EPA, 2008):

- Environmental protection processes in Western Australia including referral and environmental impact assessment procedures that apply to land use planning and development under the *Environmental Protection Act 1986*
- EPA's advice on protecting a range of biophysical factors, to assist land use planning, including:
 - Biodiversity and significant natural areas
 - Native terrestrial vegetation
 - Native terrestrial fauna
 - Wetlands
 - Waterways
 - Public drinking water source areas
 - Land degradation
 - Landscape and landforms
 - Karst, subterranean wetlands and fauna
- EPA's advice on managing potential pollutants, waste and water (pollution management factors), to assist land use planning, including:
 - Pollution management
 - Air quality
 - Water management
 - Noise and vibration
 - Light, radiation and electromagnetic fields
 - Contaminated sites
 - Waste management.
- EPA's advice on protecting aspects of the biophysical environment of cultural and social significance to the community (social surroundings factors), and the EPA's position on risk.

2.2.2 Draft State Planning Policy 2.9 Planning for Water Policy and Guidelines

2.2.2.1 Draft State Planning Policy 2.9 Planning for Water Policy

The intent of draft State Planning Policy 2.9 (SPP 2.9) is to ensure planning and development considers water resource management, including appropriate management measures to achieve optimal water resource outcomes (WAPC, 2021).

Draft SPP 2.9 consolidates multiple water-related policies and guidelines, with the overall objectives to:

- Protect and improve the environmental, social, cultural and economic values of the State's water resources
- Protect public health and the long-term supply of good quality and affordable drinking water
- Manage the risk of riverine flooding to people, property and infrastructure
- Ensure the secure and sustainable supply, use and re-use of water resources
- Ensure future development is resilient to the water related impacts of climate change
- Minimise future costs and protect public health by ensuring that appropriate wastewater infrastructure is provided.

Draft SPP 2.9 details specific management measures in relation to the Swan Canning river system are detailed as follows:

- Maintain and enhance the natural ecosystem and hydrological functions of the river system, and demonstrate detrimental impacts have been mitigated
- Demonstrate a benefit to the community and a functional need to be located within the river and/or foreshore reserves, where the proposal is located on public land
- Maintain and enhance public access to and along the rivers and its foreshores, including through the establishment of foreshore reserves
- Consider the importance of the river as a strategic water transport network for commercial and recreational use
- Maintain and enhance the natural landscape character and sense of place of the river system
- Maintain and enhance views to or from the Swan Canning river system from public places
- Identify and protect Noongar and other cultural heritage places and values
- Protect, maintain or increase vegetation coverage (preferably with endemic species)
- Maintain or establish ecological and public open space linkages to the Swan Canning river system for wildlife habitat and movement and natural water flows (WAPC, 2021).

2.2.2.2 Draft State Planning Policy 2.9 Planning for Water Guidelines

Draft SPP 2.9 guidelines provide information relevant to the implementation of the draft SPP 2.9 policy (Section 2.2.2.1). The guidelines provide advice in:

- Determining appropriate land use planning practices in relation to water resources across Western Australia
- Specifying the requirements to be met at each stage of the planning process
- Ensuring that necessary water resource management measures are incorporated into land development.

The guidelines detail what information is required at different stages of the planning and development approvals process, including:

- Addressing climate change
- Addressing cumulative impact
- Water management plans
- Environmental, social and cultural values
- Riverine flooding
- Infrastructure and supply
- Public drinking water source areas
- Peel-Harvey Coastal Plain catchment
- Swan Canning river system.

Specific to the Swan Canning river system, draft SPP 2.9 states that proposals around the Swan Canning river system should protect and enhance the ecological health, community benefits, amenity and heritage value of the Swan Canning river system for the public benefit of Western Australia (WAPC, 2021b).

2.2.3 State Planning Policy 3.7: Planning in Bushfire Prone Areas and Guidelines for Planning in Bushfire Prone Areas

State Planning Policy 3.7 (SPP 3.7) – Planning in Bushfire Prone Areas (WAPC, 2015b) and the associated Guidelines for Planning in Bushfire Prone Areas (WAPC, 2017) have been developed to implement effective risk-based land use planning and development to preserve life and reduce the impact of bushfire on property and infrastructure (WAPC, 2015b).

SPP 3.7 applies to all strategic planning, subdivision and development applications in bushfire prone areas, and aims to support development through an assessment of bushfire hazard. The aims of SPP 3.7 are to:

- Avoid increases in the threat of bushfire to people, property and infrastructure
- Reduce vulnerability to bushfire through identification and consideration of bushfire risks
- Ensure higher order strategic planning documents, proposals, subdivision and development applications take into account bushfire protection requirements
- Achieve an appropriate balance between bushfire risk management measures, biodiversity conservation values, environmental protection and biodiversity management and landscape amenity, with consideration to climate change (WAPC, 2015b).

The Guidelines for Planning in Bushfire Prone Areas (WAPC, 2017) provides guidance on the implementation of SPP 3.7, and assist in:

- Determining appropriate land use planning in relation to bushfire prone areas across Western Australia
- Specifying the requirements to be met at each stage of the planning process
- Ensuring that necessary bushfire protection measures are incorporated into development (WAPC, 2017).

3 Existing Environment

3.1 Climate

The site is located in the Perth metropolitan area, which experiences a typical Mediterranean climate, with hot, dry summers and cool, wet winters. Jandakot Aero weather station, located 8.1 km from the site, reports an annual mean rainfall of approximately 816 millimetres (mm) (BOM, 2021). Temperature ranges from 18 C (July) to 31.5 C (February) (BOM, 2021).

3.2 Landforms, Soils and Topography

Topography of the site is gently sloping, with the lowest point occurring on the north western boundary at approximately 24 metres Australian Height Datum (mAHD), reaching a high point of 34 mAHD in the south eastern corner of the site (Figure 4). The aspect of the site is generally west.

The site is located within the Bassendean Dune system of the Swan Coastal Plain. The primary soil type across the subject area is S₈, which is described as: SAND – very light grey at surface, yellow at depth, fine to medium-grained, sub-rounded quartz, moderately well sorted, of Aeolian origin (Gozzard, 1983; Figure 4).

The subject area is mapped as having a Moderate to Low Risk of Acid Sulfate Soils (ASS) occurring within 3 m of the soil surface (DWER, 2017a; Figure 4).

3.3 Hydrology

3.3.1 Groundwater

Estimated maximum groundwater levels across the site range from approximately 21 to 22 mAHD, flowing in a general westerly direction (DWER, 2017b). Groundwater is likely to occur between 5 – 7 metres below ground level (mbgl) (DWER, 2017b).

Groundwater monitoring was undertaken across three bores within the site between September 2017 and November 2018 to capture two winter peak periods (Emerge Associates, 2018). Groundwater levels in these locations fluctuated between 21.813 mAHD (E-MBO3) to 23.099 mAHD (E-MB02) (Figure 5; Appendix 1). This equates to groundwater levels across the site occurring between 3.050 to 4.829 m below ground level (mbgl), with approximately 1 m difference across the three bores at any one time.

3.3.2 Surface Water and Wetlands

There are no wetlands or watercourses recorded within the site (DBCA, 2020). No signs of water pooling or flowing across the site were noted during the ecological surveys (Coterra, 2017).

3.4 Vegetation and Flora

3.4.1 Vegetation Associations and Complexes

The site is historically representative of Beard Vegetation Association 1001, which is described as 'medium very sparse woodland; Jarrah, with low woodland; Banksia or Casuarina' (Beard et al, 2005) and the Bassendean Complex – Central and South (Figure 6; Heddle et al, 1980). The Bassendean Complex – Central and south is described as "woodland of jarrah (*Eucalyptus marginata*), *Allocasuarina fraseriana*, *Banksia attenuata*, *B. grandis* and *B. menziesii* on the sand dunes to low woodland of *Melaleuca preissiana*, *B. ilicifolia* and *B. littoralis* and sedgelands on the low-lying moister sites. This area includes the transition of jarrah to coastal blackbutt (*E. todtiana*) in the Perth vicinity and jarrah to marri (*Corymbia calophylla*) on the moister

soils. Other plant species include *Kunzea ericifolia*, *Hypocalymma angustifolium*, *Adenanthos obovatus* and *Verticordia* species (Hedde et al, 1980).

3.4.2 Vegetation Type

A detailed vegetation and flora survey was undertaken on the site (Coterra, 2017). The survey was done in accordance with relevant government guidance (EPA, 2016a). Two vegetation types were observed on the site, as follows:

- An Open Low Forest of *Banksia attenuata*, *B. ilicifolia* and *B. menziesii* with scattered *Allocasuarina fraseriana* over Open Tall Shrubland to Tall Shrubland of *Xanthorrhoea preissii*, with occasional pockets of *Kunzea glabrescens* tall shrubs, over Open Shrubland to Shrubland of *Stirlingia latifolia* over Open Low Shrubland of *Hibbertia hypericoides* or *Hypocalymma robustum* and *Bossiaea eriocarpa* or over a mixed Sedgeland/Herbland including *Phlebocarya ciliata*, and/or *Desmocladius flexuosus* and *Lepidosperma squamatum* on midslope flats, on loamy sands, was recorded predominantly in the western portion of the subject area.
- Scattered *Banksia menziesii* and *B. ilicifolia* over Shrubland to tall Shrubland of *Adenanthos cygnorum* over Open Grassland of introduced species **Ehrharta calycina* with scattered native low shrubs, on midslope sandy flats was recorded predominantly in the eastern portion of the subject area.

3.4.3 Vegetation Condition

Vegetation condition ranged from 'Completely Degraded' to 'Very Good' according to the Keighery (1994) scale (Coterra, 2017). Vegetation in the eastern portion of the site (in association with the Western Power transmission line easement) was predominantly in 'Degraded' to 'Completely Degraded' condition, and patches of 'Good' to 'Very Good' condition vegetation were identified in the western portion of the site (Coterra, 2017).

3.4.4 Threatened and Priority Flora

A targeted search for threatened and priority flora identified under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the Western Australian *Biodiversity Conservation Act 2016*, was undertaken and no flora species of conservation significance were recorded on site (Coterra, 2017). The survey was conducted during the peak Spring flowering period, within optimum search times for conservation-significant orchid species such as *Caladenia huegelii* (Coterra, 2017).

3.4.5 Threatened and Priority Ecological Communities

3.4.5.1 Banksia Woodlands of the Swan Coastal Plain ecological community

Vegetation within the western portion of the site was assessed and determined to be representative of the Banksia Woodlands of the Swan Coastal Plain ecological community (Banksia Woodlands Threatened Ecological Community (TEC)), as defined by DEE (2016a, 2016b). In summary, the key diagnostic criteria used in identifying the Banksia Woodlands TEC are addressed as follows:

- The criteria of vegetation condition is met, with the Banksia woodland in the western portion of the subject area in Very Good and Good Condition (Figure 6).
- The criteria of patch size is met, with the areas of Very Good and Good Condition mapped as 1.16 ha and 0.23 ha in size respectively.
- The criteria of an upper layer of trees of Banksia dominated or co-dominated species is met, with the tree canopy layer dominated by *Banksia attenuata*, *B. menziesii* and *B. ilicifolia*.
- The criteria of a species-rich and diverse understory is met, with 75 native understorey species recorded in this floristic community within the subject area.

- Key species in the sclerophyllous shrub layer of the ecological community including *Bossiaea eriocarpa* (common brown pea), *Daviesia* spp., *Daviesia triflora*, *Eremaea pauciflora*, *Gompholobium tomentosum* (hairy yellow pea), *Hibbertia hypericoides* (yellow buttercups), *Kunzea glabrescens*, *Petrophile linearis* (pixie mops), *Philotheca spicata* (pepper and salt), *Stirlingia latifolia* (blueboy), *Phlebocarya ciliata*, *Hypolaena exsulca* and *Xanthorrhoea preissii* (balga) were recorded (Coterra, 2017).
- Key species in the herbaceous ground layer including *Amphipogon turbinatus* (tufted beard grass), *Burchardia congesta* (milkmaids), *Caladenia* spp. (spider orchids), *Dasypogon bromeliifolius* (pineapple bush), *Desmocladus flexuosus*, *Drosera erythrorhiza* (red ink sun dew), *Lepidosperma squamatum* (a tufted sedge), *Lomandra hermaphrodita*, *Lyginia imberbis*, *Mesomelaena pseudostygia* (semaphore sedge), *Patersonia occidentalis* (purple flag), *Stylidium brunonianum* (pink fountain trigger plant), *Stylidium piliferum* (common butterfly trigger plant), *Trachymene pilosa* (dwarf parsnip), and *Xanthosia huegelii* (heath xanthosia) were recorded (Coterra, 2017).

Of the developable 2.48 ha portion of the site, the Threatened Ecological Community (TEC) comprises 1.38 ha in 'Good' (0.23 ha) to 'Very Good' (1.16 ha) vegetation (Coterra, 2017). The remaining 1.1 ha of banksia woodland in 'Degraded' to 'Completely Degraded' condition cannot be defined as Banksia Woodland TEC due to its poor condition.

3.4.5.2 Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the Swan Coastal Plain ecological community

A patch, in respect of the Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the Swan Coastal Plain ecological community is defined as containing at least three established Tuart trees, with no more than 40 metres between their canopies (DEE, 2017a). Only two Tuart trees were recorded on site, approximately 8 m apart (Coterra Environment, 2017).

Whilst the Tuart Woodlands TEC can co-occur with the Banksia Woodlands TEC, in cases where Tuart occurs as an occasional emergent above a stratum dominated or co-dominated by Banksia species, the patch is likely to be the Banksia Woodlands TEC (DEE, 2017a), as demonstrated through an assessment of key diagnostic characteristics (Coterra, 2017). As such, no further assessment was made as to the possible occurrence of the vegetation belonging to the Tuart Woodlands TEC.

3.4.6 Bush Forever and Ecological Linkages

3.4.6.1 Bush Forever

Multiple Bush Forever sites are located in the vicinity of the site within State-managed conservation reserves (Figure 8), including:

- Bush Forever (BF) Site 392 (Harry Waring Marsupial Reserve, Wattleup)
Located approximately 1.3 km west of the site (Landgate, 2021b). BF Site 392 contains approximately 271 ha of bushland on Bassendean and Spearwood Dunes (DEP, 2000). Vegetation includes Floristic Community Type (FCT) 21a, 23a and 28, which can be attributed to the Banksia Woodlands TEC (DEP, 2000; DEE, 2016a).
- Bush Forever Site 492 (Lyon Road Bushland, Banjup)
Located approximately 1.3 km northeast of the site (Landgate, 2021b). BF Site 492 contains approximately 25 ha of bushland on Bassendean Dunes (DEP, 2000). Vegetation includes FCT 21a, 21c and 23a, which can be attributed to the Banksia Woodlands TEC (DEP, 2000; DEE, 2016a).
- Bush Forever Site 268 – Mandogalup Road Bushland, Mandogalup
Located approximately 2.2 km southwest of the site (Landgate, 2021b). BF Site 268 contains approximately 96 ha of bushland on Bassendean and Spearwood Dunes (DEP, 2000). Vegetation

includes FCT 25 and 28, which can be attributed to the Banksia Woodlands TEC (DEP, 2000; DEE, 2016a).

- Bush Forever Site 391 (Thomsons Lake Nature Reserve and Adjacent Bushland, Beeliar)

Located approximately 2.6 km northwest of the site (Landgate, 2021b). BF Site 391 contains approximately 366 ha of bushland on Bassendean and Spearwood Dunes (DEP, 2000). Vegetation includes FCT 24 and 28, which can be attributed to the Banksia Woodlands TEC (DEP, 2000; DEE, 2016a).

- Bush Forever Site 263 – Banjup Bushland, Banjup

Located approximately 2.8 km northeast of the site (Landgate, 2021b). BF Site 263 contains approximately 104 ha of bushland on Bassendean Dunes (DEP, 2000). Vegetation includes FCT 21c, 22 and 23a, which can be attributed to the Banksia Woodlands TEC (DEP, 2000; DEE, 2016a).

- Bush Forever Site 267 – Mandogalup Road Bushland, Hope Valley

Located approximately 3.2 km southwest of the site (Landgate, 2021b). BF Site 267 contains approximately 15 ha of bushland on Spearwood Dunes (DEP, 2000). Vegetation includes FCT 28, which can be attributed to the Banksia Woodlands TEC (DEP, 2000; DEE, 2016a).

- Bush Forever Site 347 – Wandi Nature Reserve and Anketell Road Bushland, Wandi/Oakford

Located approximately 3.2 km southeast of the site (Landgate, 2021b). BF Site 347 contains approximately 412 ha of bushland on Pinjarra Plains and Bassendean Dunes. Vegetation includes FCT 22 and 23a, which can be attributed to the Banksia Woodlands TEC (DEP, 2000; DEE, 2016a).

- Bush Forever Site 344 – Denis De Young Reserve and Gibbs Road Swamp Bushland, Banjup/Forrestdale

Located approximately 3.3 km northeast of the site (Landgate, 2021b). BF Site 344 contains approximately 289 ha of bushland on Bassendean Dunes (DEP, 2000). Vegetation includes FCT 21c and 22, which can be attributed to the Banksia Woodlands TEC (DEP, 2000; DEE, 2016a).

3.4.6.2 Ecological linkages

The portion of the site contained within the Western Power easement is identified by the City of Cockburn as a local ecological linkage. Local ecological linkages aim to link protected locally significant patches to each other, regionally significant patches and regional ecological linkages (Molloy et al., 2009).

3.4.7 Bush Fire Risk

The site is located in a mapped bushfire prone area, as defined by the Department of Fire and Emergency Services (Landgate, 2021). These areas are defined as being subject to, or likely to be subject to, bush fire attack, and are identified by the presence of and proximity to bush fire prone vegetation and includes both the area containing the bush fire prone vegetation and a 100 m buffer zone immediately surrounding it (Landgate, 2021).

3.5 Fauna Habitat and Fauna

3.5.1 Fauna Habitat

A fauna habitat survey was undertaken on site in accordance with relevant government guidance (EPA, 2002, 2016b; EPA & DEC, 2010). Banksia Woodland was identified across the majority of the site as representing fauna habitat (Figure 6), noting variable condition of vegetation (Coterra, 2017).

3.5.1.1 Black Cockatoo Habitat

The following dominant trees and shrub species identified on site that present potential foraging habitat for black cockatoos (Carnaby's Black Cockatoo, Baudin's Black Cockatoo, Forest Red-tailed Black Cockatoo):

- *Banksia attenuata*
- *Banksia menziesii*
- *Banksia ilicifolia*
- *Eucalyptus marginata* (Jarrah)
- *Allocasuarina fraseriana* (Sheoak)
- *Xanthorrhoea preissii* (Balga) (Coterra, 2017).

An assessment of foraging value was undertaken on site, based on habitat density and canopy cover (averaging 10-30% canopy cover). Habitat at the site represents low to moderate foraging value for black cockatoos (Coterra, 2017).

No black cockatoo breeding or roosting habitat trees were identified on site (Coterra, 2017).

3.5.2 Fauna Occurrence

Whilst database searches identified numerous fauna species as potentially occurring on the site, within the broader context of the Swan Coastal Plain bioregion, only four birds and one mammal, of which none are conservation-significant, were recorded on site (Coterra, 2017).

3.5.3 Significant Fauna Species

Of the EPBC conservation-significant species identified as potentially occurring on site, three black cockatoo species and Rainbow Bee-eater, none of these species were recorded on site (Coterra, 2017).



4 Potential Environmental Impacts and Proposed Management

4.1 Soils and Topography

4.1.1 Potential Impacts

The site is mapped in a 'moderate to low' risk ASS area (Section 3.2). Disturbance to ASS has the potential to create an acidic environment, which may impact groundwater if not appropriately managed.

4.1.2 Management Measures

Once detailed engineering and construction details are available, an ASS self-assessment form (WAPC, 2020; Appendix 2) should be completed, and if there is potential for ASS to be impacted by the development, an ASS investigation should be undertaken. The ASS investigation and management plan should be undertaken in accordance with the following:

- Identification and Investigation of Acid Sulfate Soils and Acidic Landscapes (DER, 2015a)
- Treatment and Management of Soils and Water in Acid Sulfate Soil Landscapes (DER, 2015b).

These investigations and management plans could be undertaken as a condition of subdivision approval.

4.2 Groundwater and Stormwater

4.2.1 Potential Impacts

The development will be managed to avoid adverse impacts to groundwater which could then have an impact on nearby waterbodies.

4.2.2 Management Measures

A Local Water Management Strategy (LWMS) has been prepared for the site by Development Engineering Consultants (December 2021), to outline groundwater and stormwater management initiatives in respect of the development.

4.2.2.1 Stormwater Management

Stormwater management on the site post development will be based on the principles of water sensitive urban design and use best management practices consistent with draft SPP 2.9 (WAPC, 2021). Stormwater management will also be required to be consistent with local government requirements.

The LWMS demonstrates that stormwater is able to be appropriately managed. The following approach is proposed for the site (DEC, 2021):

- Drainage will be directed to the existing POS/Drainage area located in Lot 8001 which is east of Westwood Crescent in the development of former Lot 29 Barfield Road, and immediately north of Lot 28. The swale will be designed to ensure all events up to the major 1% AEP storm is infiltrated on site.
- Bio Retention areas will be constructed at the proposed drainage outlet to provide nutrient uptake during the infiltration process.
- The 1% AEP storm will be wholly contained within POS area
- All roads within the estate will be designed to accommodate and direct extreme event flows towards each POS and drainage basin
- The development is proposed to be filled a minimum of 300mm above the top water level of drainage basins to ensure conveyance for major storms will be along the roadways without flooding homes.

4.2.2.2 Water Quality Management

The following water quality management measures are proposed for the site (DEC, 2021):

- Construction activities will be managed to ensure stormwater pollution is minimised (see section 6.8 of LWMS for further detail)
- Surface water will be routed to swale basins and retained on site
- To achieve significant reductions of total suspended solids, total phosphorus and total nitrogen and gross pollutants, the following best management measures are proposed (DEC, 2021):
 - Non structural measures will be implemented to reduce applied nutrient loading
 - On site retention of 63.22% AEP 1 hour storm

4.2.2.3 Groundwater Management

Required groundwater clearances will be achieved at the site through design measures.

Fill is required on site to integrate the development with existing residential developments to the north and south of the site, allow the site to be gravity-sewered and drained.

In general, the groundwater levels are several metres below the site levels. Therefore, development levels are generally at a minimum of RL25.6mAHD, which is above the maximum likely groundwater level. Subsequently, there is no further need for controls of groundwater levels and all drainage pipework will be laid well above the controlled groundwater levels (DEC, 2021).

4.3 Vegetation and Flora

4.3.1 Potential Impacts

With exception to the Public Open Space, future residential development of the site will result in clearing of native vegetation within the western portion of the site. Within the powerline easement, retention of 0.72 ha of vegetation is proposed with the remaining area proposed for bulk earthworks and a road reserve which will connect with the development to the south, this arrangement having been accepted by Western Power. The potential for bushfire risks associated with retained and planted vegetation should also be considered.

4.3.2 Management Measures

4.3.2.1 Vegetation Retention

Existing vegetation will be retained within the easement (0.72 ha) and within the Public Open Space (0.13 ha) (Figure 3). The vegetation proposed for retention within the easement is comprised of degraded shrubland, which contains scattered *Banksia menziesii* and *B. ilicifolia* but is dominated by *Adenanthos cygnorum*. Within the Public Open Space the vegetation proposed for retention is comprised of an open low forest of *Banksia attenuata*, *B. ilicifolia* and *B. menziesii* with scattered *Allocasuarina fraseriana*.

The vegetation proposed for retention within the easement is predominantly in 'Degraded-Completely Degraded' condition, or existing cleared tracks, with the vegetation proposed for retention in the Public Open Space being predominantly in 'Very Good' condition (Figure 7).

The banksia species present, as well as some scattered jarrah (*Eucalyptus marginata*), sheoak (*Allocasuarina fraseriana*) and grasstree (*Xanthorrhoea preissii*) provide potential foraging habitat to some or all of the protected black cockatoo species possibly present in the area (Table 1).

Table 1 Dominant tree and shrub species that may provide Black Cockatoo foraging species

Tree/Shrub Species	Carnaby's Black Cockatoo	Baudin's Black Cockatoo	Forest Red-Tailed Black Cockatoo
<i>Banksia attenuata</i>	X	X	
<i>Banksia ilicifolia</i>	X	X	
<i>Banksia menziesii</i>	X	X	
<i>Allocasuarina fraseriana</i>		X	X
<i>Xanthorrhoea preissii</i>	X	X	
<i>Eucalyptus marginata</i>	X	X	X

Sources: (DEE, 2017b; Groom, 2011)

To protect vegetation retention areas, the following management measures will be implemented:

- vegetation retention areas will be fenced prior to, and during construction to prevent inadvertent access and/or damage to these areas
- weed control will be undertaken (Section 4.3.2.2).

4.3.2.2 Weed control

It is proposed that weed control works be undertaken in areas of retained vegetation to improve the quality and condition of vegetation. Weed control works will be implemented in all areas of retained vegetation as follows pre- and post-planting.

Pre-planting weed control will comprise:

- initial spot-spraying of broad spectrum herbicide application (i.e. Glyphosate) in autumn, 2-4 weeks prior to winter planting.

Post-planting weed control will comprise:

- spot-spraying of broad spectrum herbicide application (i.e. Glyphosate) in late winter/spring following planting to allow for additional removal of weeds prior to flowering and seed propagation
- broad spectrum herbicide application (i.e. Glyphosate) in summer, to coincide with summer active weeds
- annual winter/spring broad spectrum herbicide application (i.e. Glyphosate), as required
- annual summer broad spectrum herbicide application (i.e. Glyphosate), as required.

4.3.2.3 Landscaping and Street Tree Planting

It is proposed to plant street trees with black cockatoo foraging value, as per Groom (2011) and the City of Cockburn's street tree species list (Table 2). Similar street planting approaches are proposed for other residential developments in Hammond Park.

These trees should also be considered in the context of bushfire risk through appropriate spacing and understorey design/management.

Table 2 City of Cockburn approved street trees that may provide Black Cockatoo foraging species

Tree Species	Common Name	Ecological Corridors	Residential Wide Verges	Residential Narrow Verges
<i>Agonis flexuosa</i>	WA Weeping Peppermint	X	X	
<i>Callistemon viminalis</i>	Weeping Bottlebrush/Captain Cook Bottlebrush	X		X
<i>Corymbia ficifolia</i>	Red Flowering Gum	X		X
<i>Hakea laurina</i>	Pin Cushion Hakea			
<i>Hibiscus tiliaceus rubra</i>	Red Cottonwood		X	
* <i>Jacaranda mimosifolia</i>	Jacaranda		X	
* <i>Liquidamber styraciflua</i>	Liquidamber		X	
* <i>Prunus (amygdalus) dulcis</i>	Almond Tree		X	

Sources: (City of Cockburn, undated; Groom, 2011)

Specific street tree species will be determined for suitability by a Landscape Architect.

4.3.3 Public Open Space

As a result of extensive consultation with the City of Cockburn, the Public Open Space will be developed into two areas, being (Smith Bushfire Consultants 2022; Appendix 3):

- Retained vegetation within the northern portion of the Public Open Space:
 - area will be managed but little other intervention will occur as this area will have the current overstorey, near surface vegetation and surface vegetation retained. Public access into this area will be limited and may require some low-visual impact fencing.
 - This will be an area of around half the POS.
 - The area meets the requirements under AS 3959 section 2.2.3.2 (c) Exclusion – Low threat vegetation criteria and therefore, does not impact the BAL ratings of the neighbouring lots. The City of Cockburn will decide how to manage the bushfire fuel load so that it meets their objectives and requirements.
- Cleared vegetation within the southern portion of the Public Open Space:
 - The development options for this area will be refined and developed in partnership with the City of Cockburn.
 - The development will consider the surrounding area recreation facilities and may have a basic children play facility and a BBQ area.
 - The development and any revegetation will meet the requirements under AS 3959 section 2.2.3.2 (c) Exclusion – Low threat vegetation and non-vegetated areas criteria and therefore will not impact the BAL ratings of the neighbouring lots

A concrete path that is 1.5 -2 metres wide supported by 6 metres of cleared land will be constructed around the Public Open Space. A limestone path, approximately 1 metre wide supported by 2 metres of clearing along the edge of the boundary between the retained and cleared vegetation and then through a small portion of the retained vegetation is also proposed. These paths will provide community access to the Public Open Space and limit dieback introduction (Smith Bushfire Consultants 2022; Appendix 3).

4.3.4 Revegetation within the easement

The area proposed for earthworks will be revegetated by the proponent to the requirements of the City of Cockburn as a condition of subdivision approval for the residential development. These revegetation works must also comply with conditions imposed on revegetation within easements by Western Power (undated).

A standard revegetation methodology will be adopted for works within the easement (Appendix 3).

4.3.5 Bush Fire

Given the site is in a bush fire prone area (Section 3.4.7), a Bushfire Management Plan is being prepared for the site by Smith Bushfire Consultants, in accordance with the following:

- *State Planning Policy 3.7 – Planning in Bushfire Prone Areas* (WAPC, 2015b)
- *Guidelines for Planning in Bushfire Prone Areas* (WAPC, 2017).

Reference should be made to the Bushfire Management Plan for specific bushfire management details.

4.4 Fauna

4.4.1 Potential Impacts

Potential impacts to fauna during vegetation clearing, should be considered and managed. Impacts to fauna from construction are associated with removal of habitat, and animal injury/fatality from the use of machinery.

4.4.2 Management Measures

A Fauna Trapping and Relocation Management Plan should be prepared as a condition of subdivision approval. Some fauna management actions that should be included within the management plan, include the following:

- Clearing outside of the main avifauna breeding season is recommended, if possible.
- Prior to the commencement of clearing the clearing and construction boundary will be surveyed to ensure it is accurately located and demarcated.
- A fauna relocater will be engaged to inspect trees and to undertake fauna relocation, *if deemed necessary*. A Licence to Take or Disturb Fauna for the purpose of Relocating will be submitted to the Department of Biodiversity, Conservation and Attractions (DBCA) prior to tree removal commencing so this approval is in place, should it be required. A copy of the approved DBCA licence will be provided to the City of Cockburn prior to the commencement of works.
- Clearing will be undertaken in the direction of retained vegetation to encourage any remaining fauna to move in this direction.
- Any vehicles on site will be restricted to the clearing and construction area footprint to minimise impact to vegetation beyond this boundary. Vehicle movements will be restricted to speeds of 30 km/hour
- If any fauna is located and/or injured, contact the Project Superintendent or Environmental Consultant for instructions. If these representatives cannot be reached, contact the DBCA Wildcare helpline (9474 9055).

Whilst the proposed development will not result in a significant impact on Matters of National Environmental Significance protected under the EPBC Act, a referral of the project under this legislation was submitted in October 2021. On 1 December 2021, the Commonwealth determined the proposed action to clear vegetation to construct a residential development on Lot 28 to be not a controlled action.

4.5 Noise

A noise assessment was undertaken for the proposed development in relation to future noise impact from the Kwinana Freeway (Lloyd George Acoustics, 2021). The assessment was conducted in respect of State Planning Policy No. 5.4 Road and Rail Noise (WAPC, 2019), which considers anticipated traffic and associated traffic noise volumes for the next 20 years from when the noise assessment was undertaken. The assessment considered both indoor and outdoor noise targets.

The noise assessment identified three specific noise management areas within the development:

- No noise management required on western-most lots along Barfield Road (13 lots)
- Package A noise management measures within central 26 lots, where noise levels are between 51 dB and 53 dB $L_{Aeq}(Night)$
- Package B noise management measures within eastern 10 lots adjacent to power line easement, where noise levels are between 54 dB and 57 dB $L_{Aeq}(Night)$.

Reference should be made to the noise assessment for specific noise management details.

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Figures

Figure 1 Regional location

Figure 2 Site location

Figure 3 Proposed development plan

Figure 4 Soils and topography

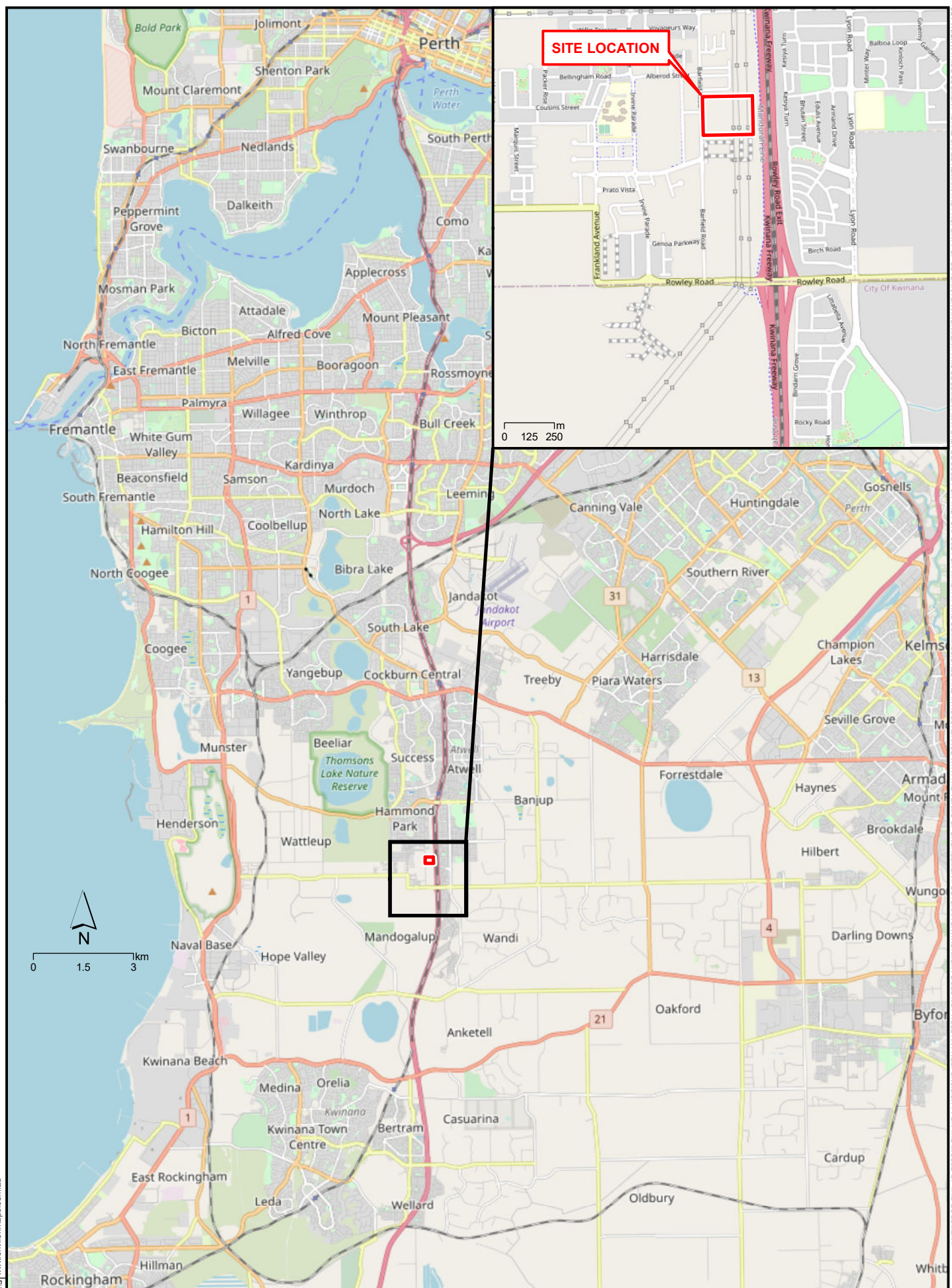
Figure 5 Hydrological features

Figure 6 Vegetation complexes and units

Figure 7 Vegetation condition

Figure 8 Bush Forever and ecological linkages

Figure 9 Proposed revegetation area





LEGEND

- Site Boundary
- Cadastre
- Easement
- Contour (mAHD)
- - - High Voltage Overhead Transmission Line

N

0 5 10 20 30 40 m

Scale: 1:1,000 @ A3
GDA 1994 MGA Zone 50

ENVIRONMAPS Environmental Mapping Solutions t: 0406 590 006 www.environmaps.com.au

Source: Orthophoto - NearMaps, 05.08.21

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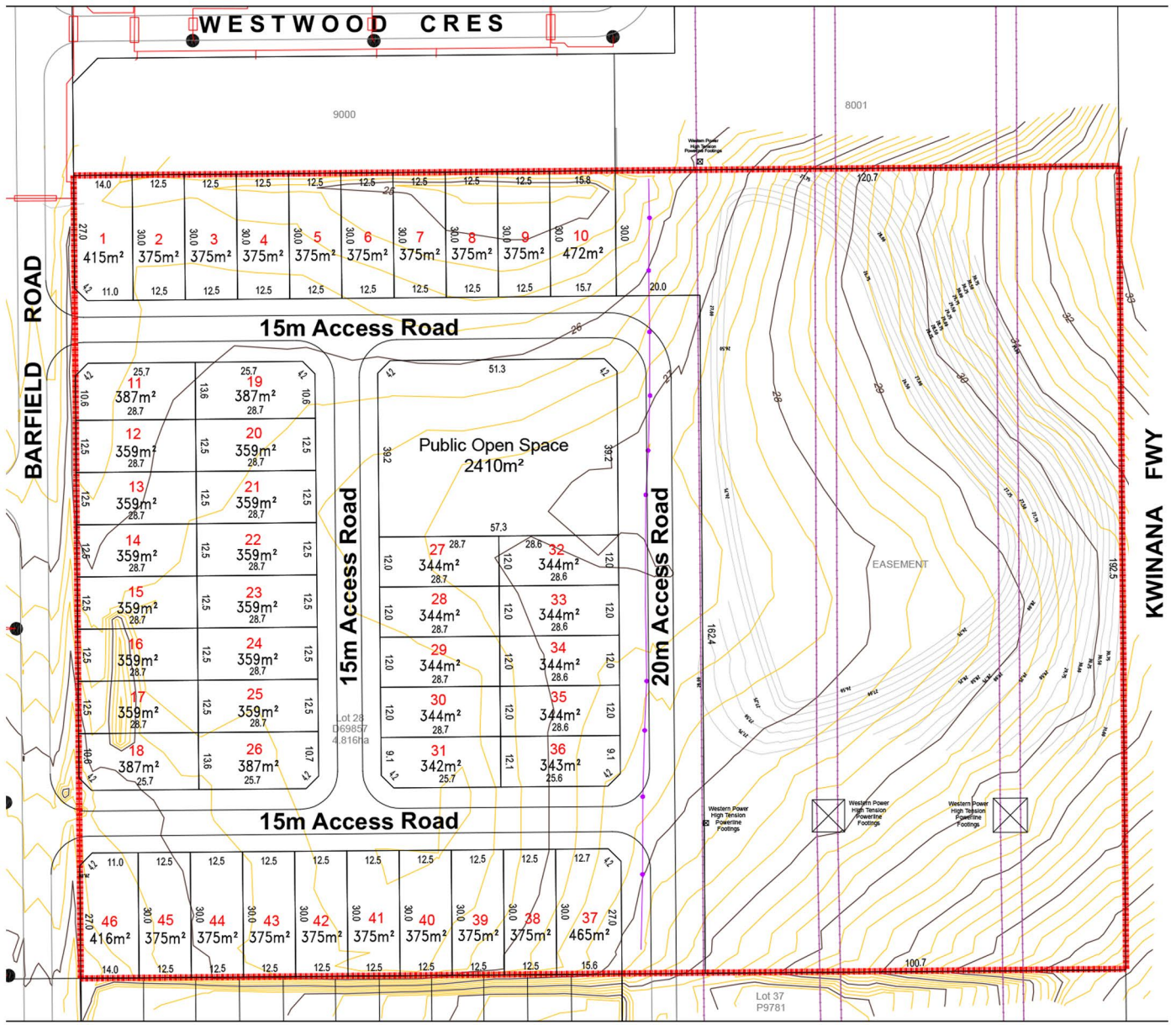
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SITE LOCATION

Figure 2



0 25 50 m

Source: Structure Plan, Michael Glendinning

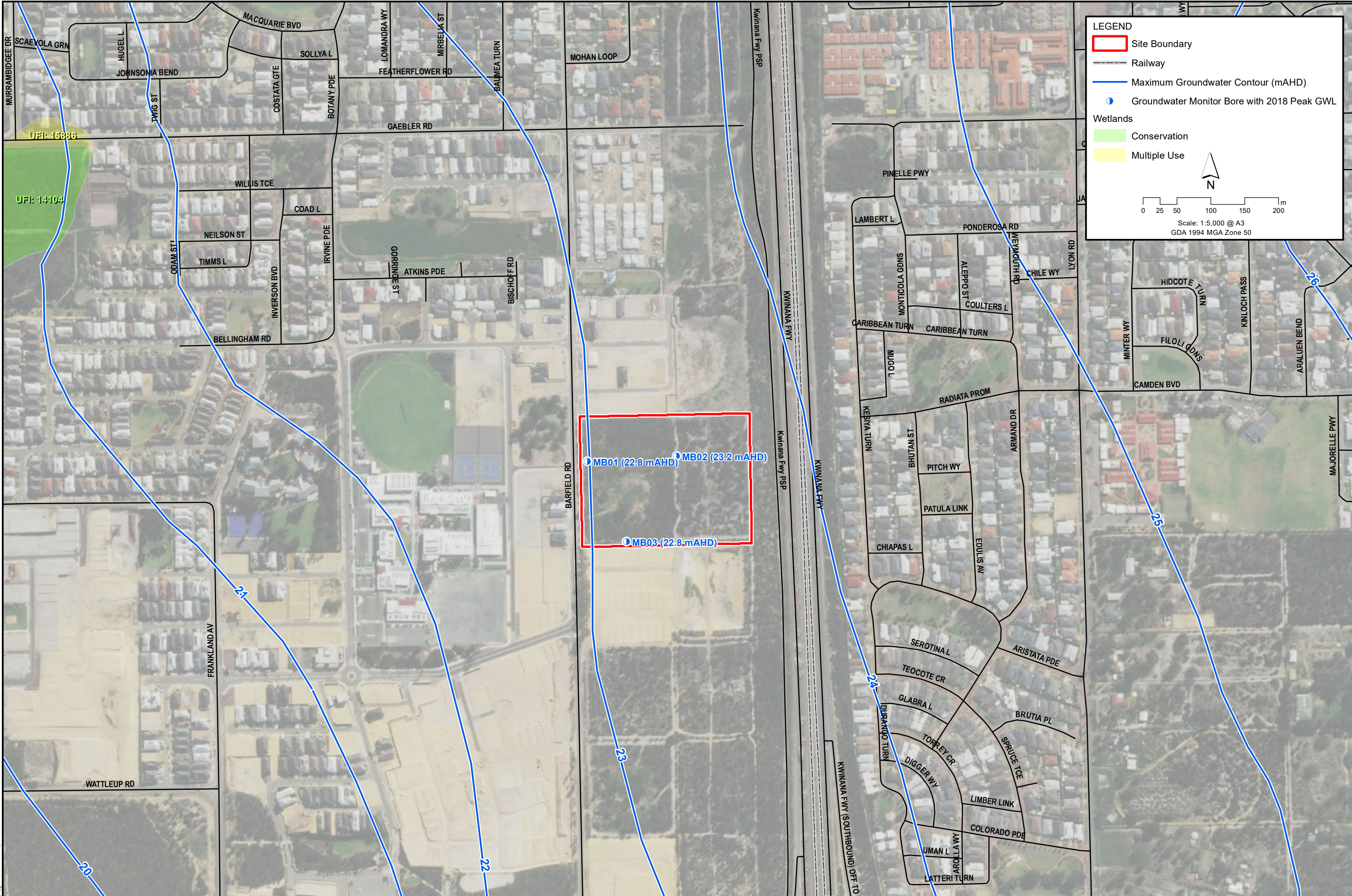
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PROPOSED DEVELOPMENT PLAN

Figure 3



ENVIRONMENTAL MAPS
Environmental Mapping Solutions
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Source: Orthophoto - Open Source
Wetlands - DBCA 2021
Groundwater Contours - DWER, 2021

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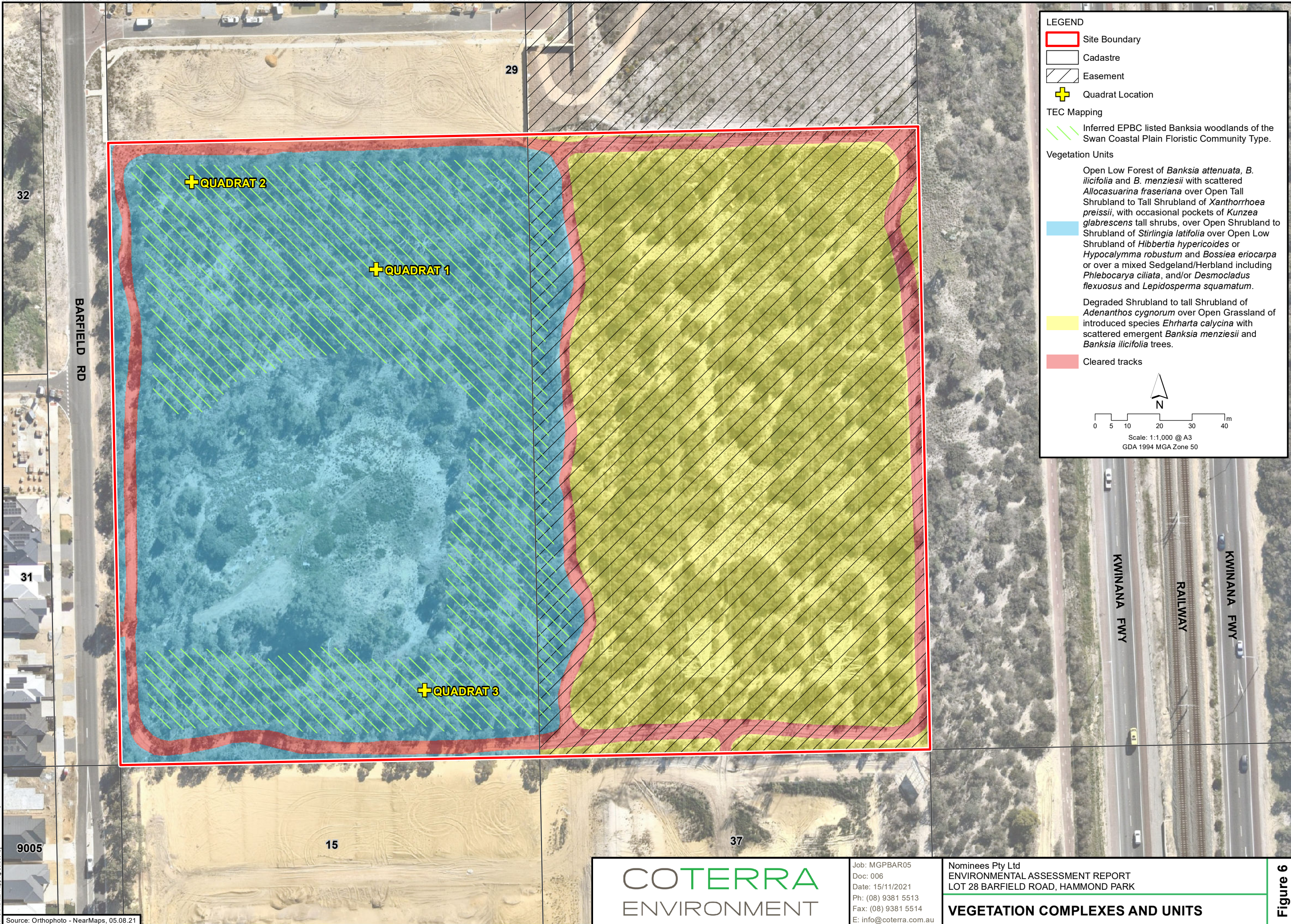
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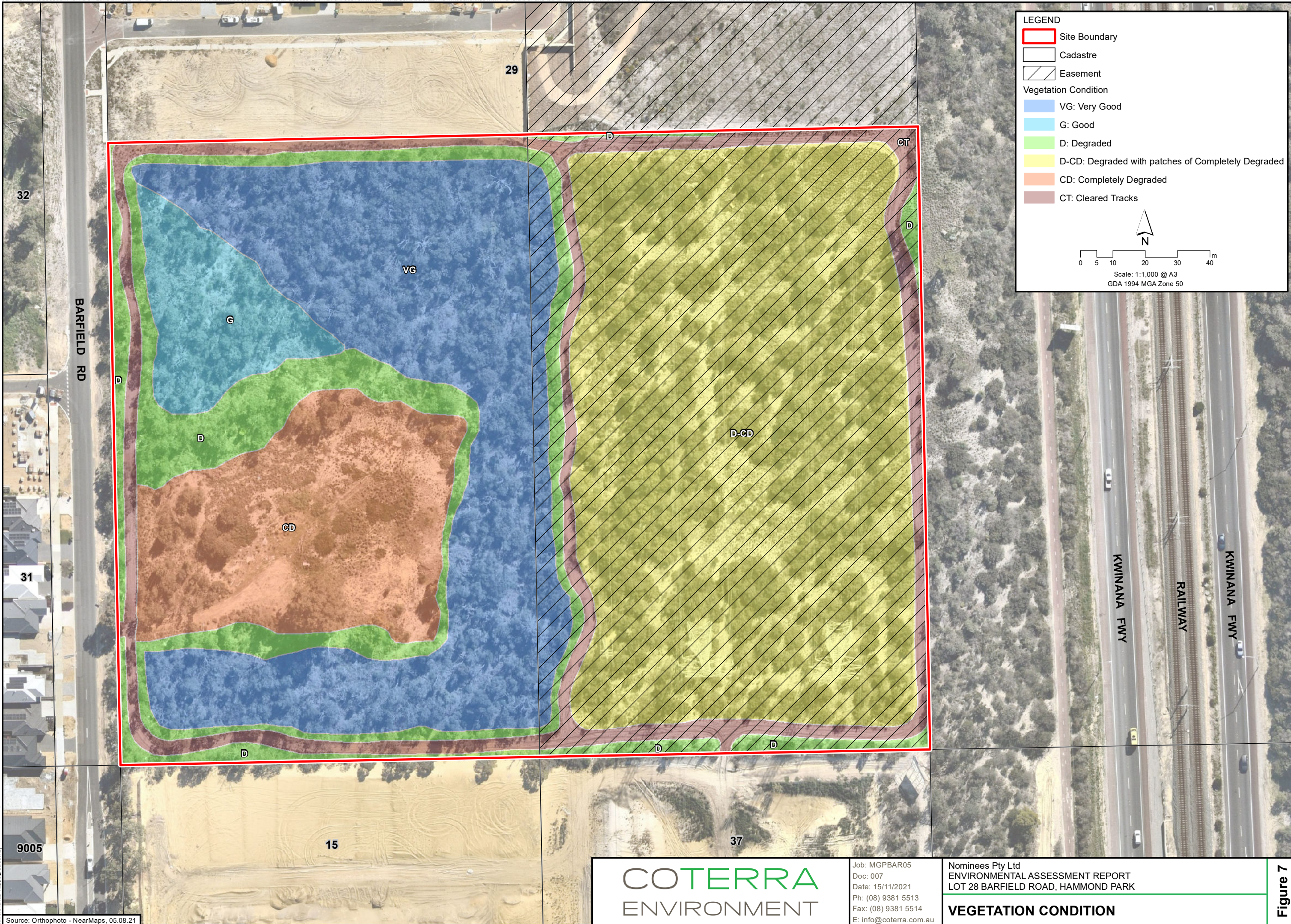
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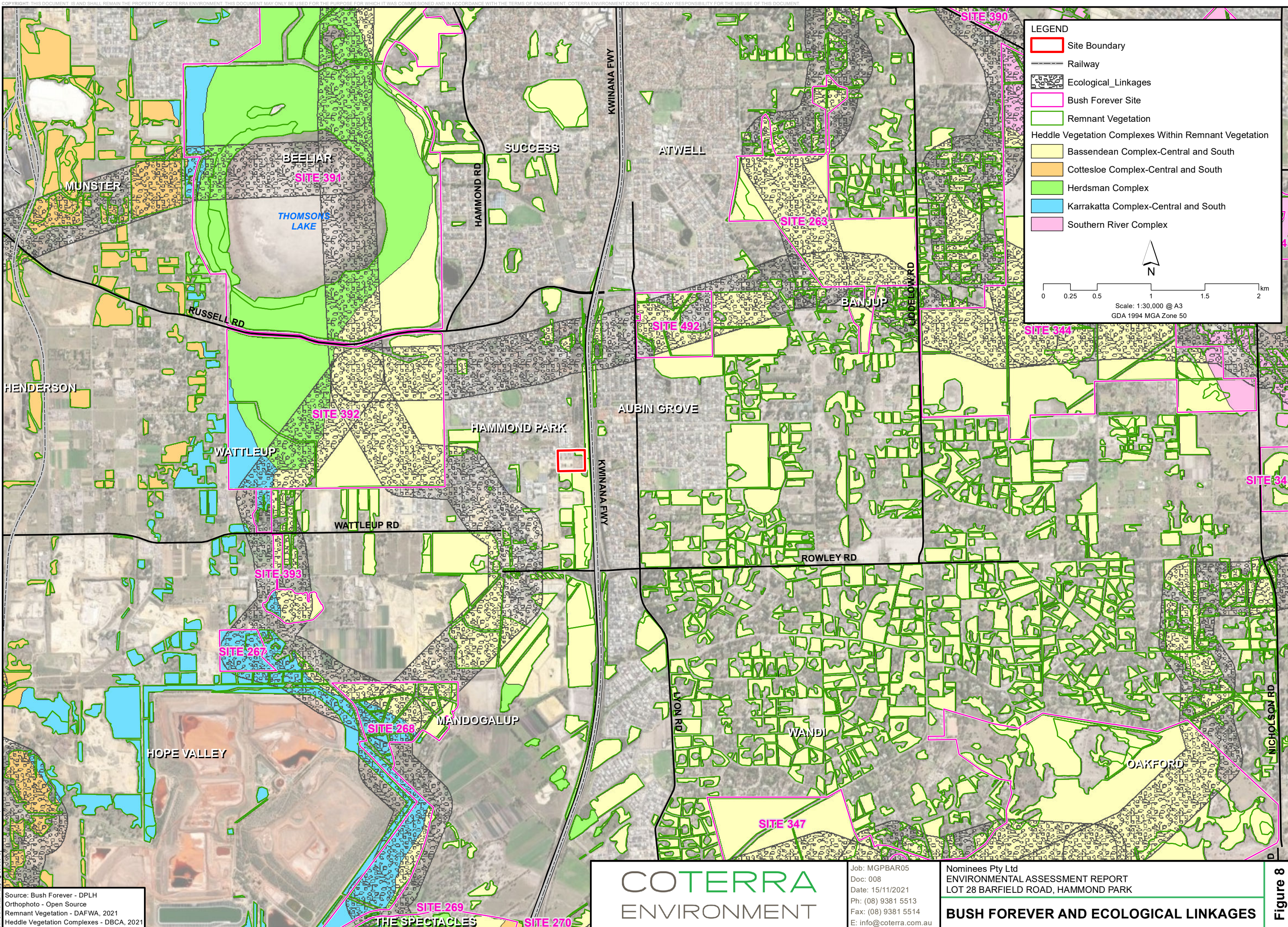
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HYDROLOGICAL FEATURES

Figure 5







Source: Bush Forever - DPLH
Orthophoto - Open Source
Remnant Vegetation - DAFWA, 2021
Heddle Vegetation Complexes - DBCA, 2021

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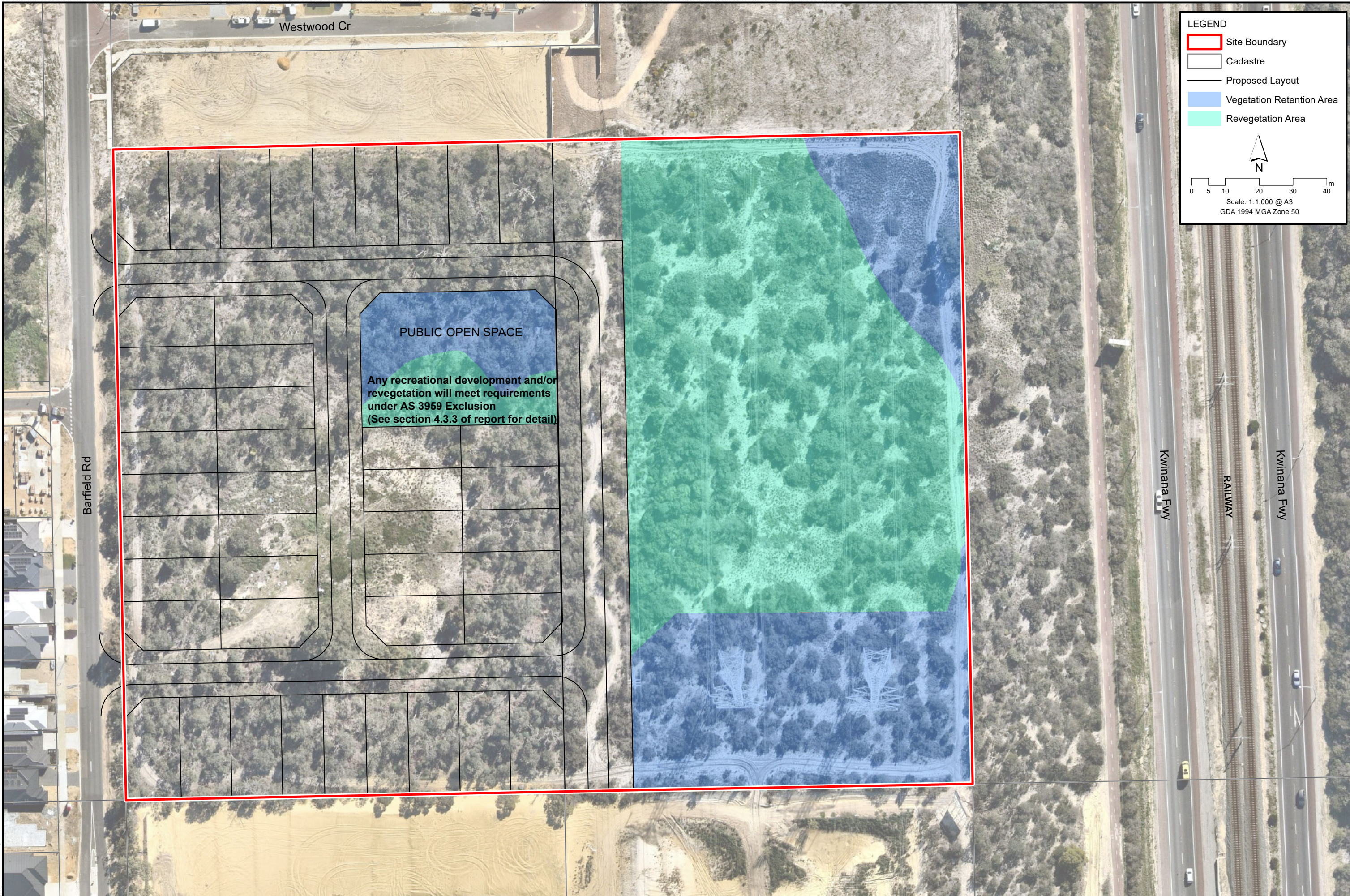
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BUSH FOREVER AND ECOLOGICAL LINKAGES

Figure 8

ENVIRONMAPS | 0406 590 006
Environmental Mapping Solutions | www.environmentmaps.com.au
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LEGEND

- Site Boundary
- Cadastre
- Proposed Layout
- Vegetation Retention Area
- Revegetation Area

N

0 5 10 20 30 40 m

Scale: 1:1,000 @ A3
GDA 1994 MGA Zone 50

PUBLIC OPEN SPACE

Any recreational development and/or
revegetation will meet requirements
under AS 3959 Exclusion
(See section 4.3.3 of report for detail)

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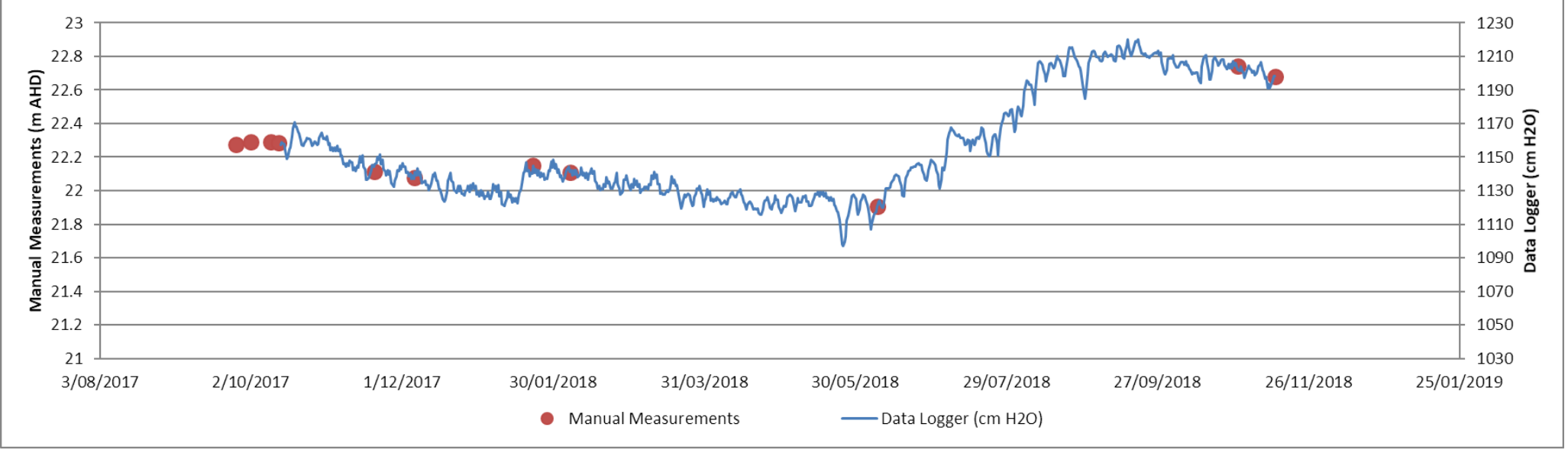
PROPOSED REVEGETATION AREA

Figure 9

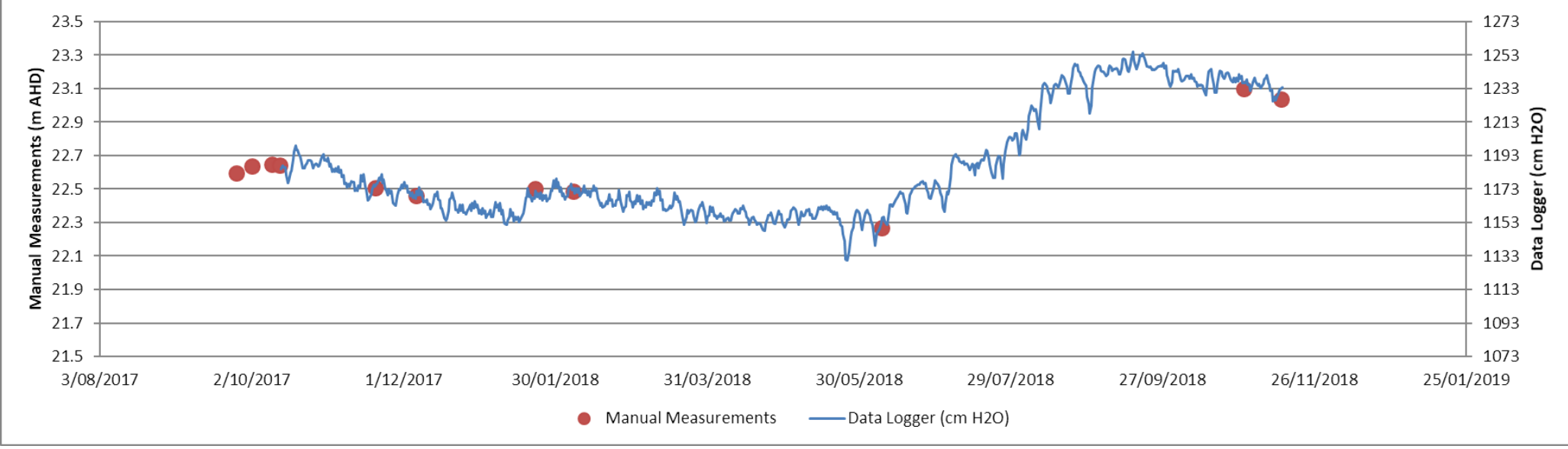


Appendix 1 Groundwater monitoring results (Emerge Associates, 2018)

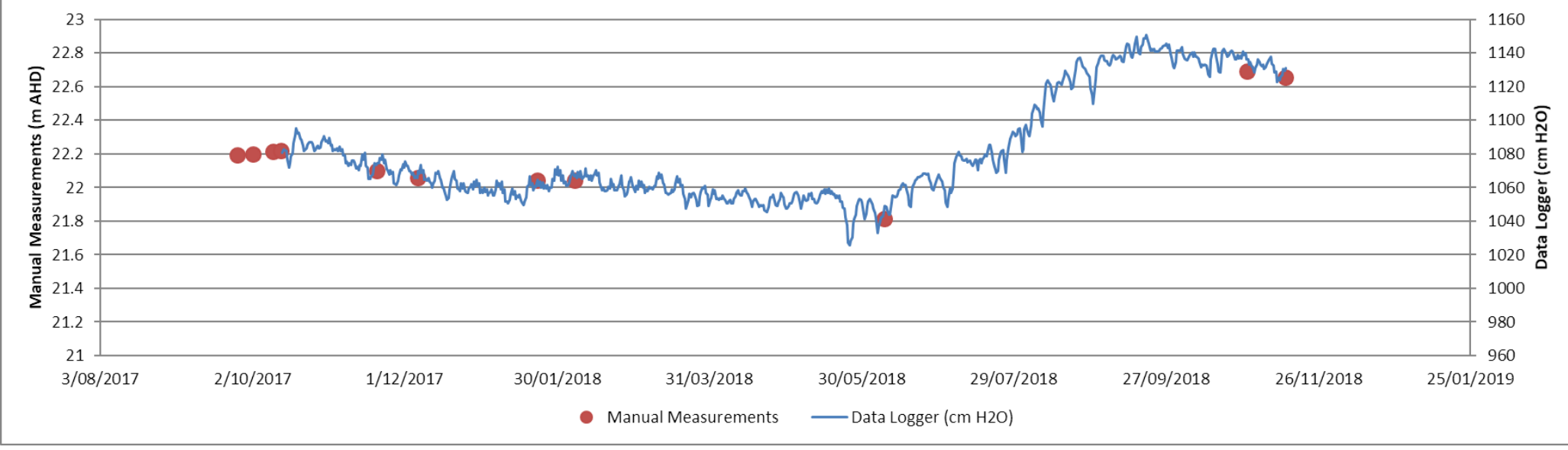
E-MB01



E-MB02

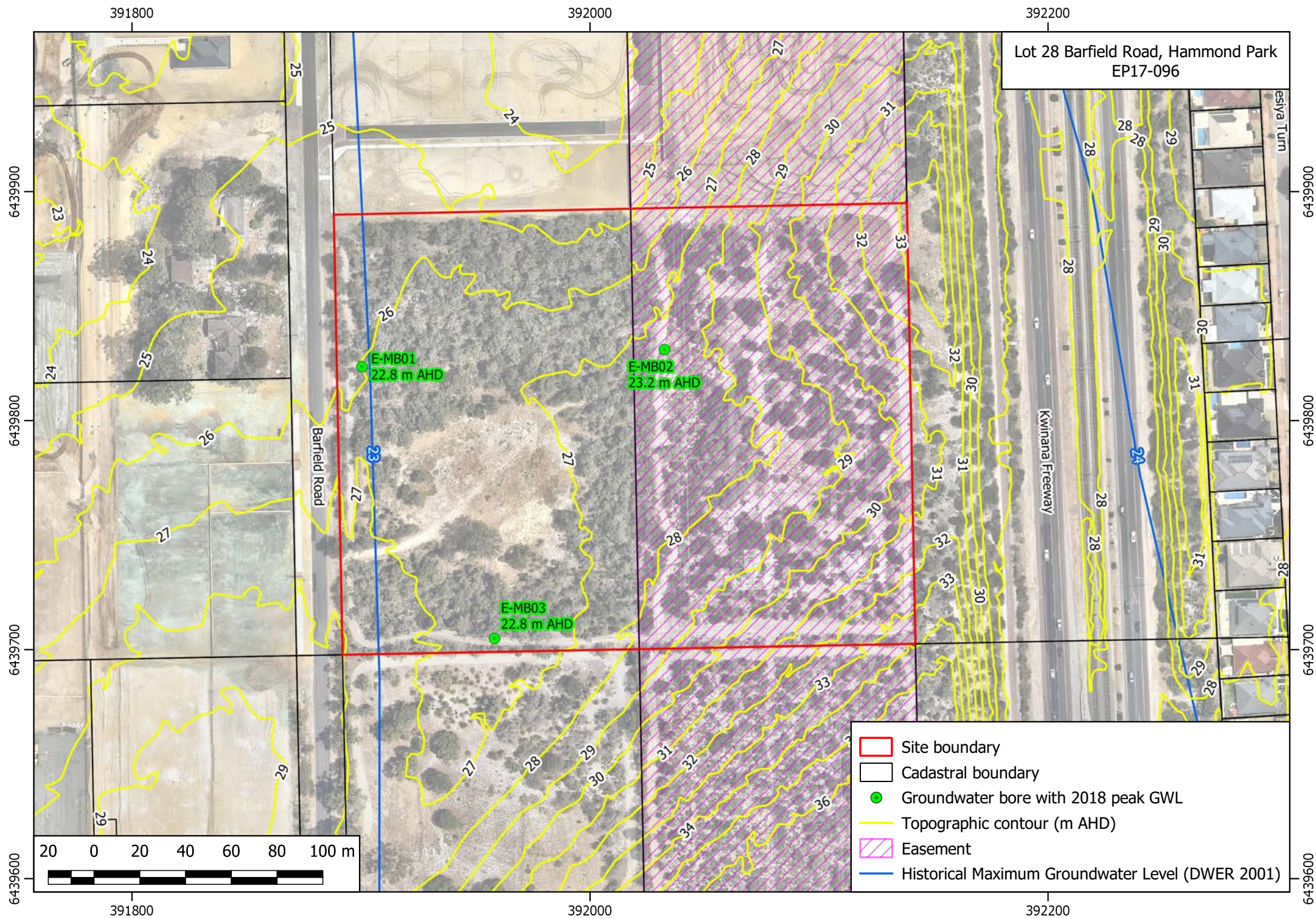


E-MB03



Summary of manual groundwater level measurements:

Date	E-MB01		E-MB02		E-MB03	
	m AHD	m BGL	m AHD	m BGL	m AHD	m BGL
26/09/2017	22.273	3.517	22.596	4.504	22.195	4.275
2/10/2017	22.290	3.500	22.639	4.461	22.198	4.272
10/10/2017	22.291	3.499	22.650	4.450	22.213	4.257
13/10/2017	22.284	3.506	22.643	4.457	22.219	4.251
20/11/2017	22.116	3.674	22.507	4.593	22.098	4.372
6/12/2017	22.077	3.713	22.462	4.638	22.059	4.411
22/01/2018	22.151	3.639	22.500	4.600	22.044	4.426
6/02/2018	22.110	3.680	22.488	4.612	22.045	4.425
8/06/2018	21.906	3.884	22.271	4.829	21.813	4.657
29/10/2018	22.740	3.050	23.099	4.001	22.694	3.776
13/11/2018	22.679	3.111	23.036	4.064	22.655	3.815



Groundwater Quality -2017/2018

Site Name	Date of Sampling	Field Chemistry						Nutrients and Nutrient Species					
		Temperature	Electrical Conductivity	Dissolved Oxygen	Dissolved Oxygen	pH	Oxidation-Reduction potential	Ammonia (NH ₃) as N	Oxides of Nitrogen (NO _x) as N	Total Kjeldahl Nitrogen (TKN) as N	Total Nitrogen (TN) as N	Total Phosphorous (TP) as P	Reactive Phosphorous (ORP) as P
		°C	mS/cm	mg/L	% sat	pH units	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
E-MB01	10/10/2017	20.5	0.488	1.90	21.1	4.45	-60.3	0.10	<0.01	1.4	1.4	0.04	<0.01
E-MB01	22/01/2018	20.0	0.644	0.34	3.9	4.42	63.1	0.14	<0.01	1	1.0	0.02	<0.01
E-MB01	29/10/2018	18.2	0.965	0.42	4.5	5.13	-214.0	0.05	<0.01	1.2	1.2	0.01	<0.01
E-MB02	10/10/2017	19.2	0.246	1.76	18.9	5.15	-51.2	0.02	1.81	0.40	2.2	0.03	<0.01
E-MB02	22/01/2018	21.7	0.223	0.48	5.5	5.32	54.1	<0.01	0.58	0.30	0.9	0.01	<0.01
E-MB02	29/10/2018	20.5	0.444	0.79	8.7	5.69	-263.0	0.03	5.13	1.00	6.1	0.03	<0.01
E-MB03	10/10/2017	18.2	0.601	1.31	13.8	5.67	-106.4	0.15	<0.01	0.6	0.6	0.03	<0.01
E-MB03	22/01/2018	20.4	0.493	0.28	3.1	5.88	-80.9	0.01	0.35	0.3	0.6	0.01	<0.01
E-MB03	29/10/2018	18.5	0.810	0.36	3.9	5.87	-286.0	0.10	<0.01	0.4	0.4	0.01	<0.01

Minimum	18.2	0.223	0.28	3.10	4.42	-263.0	0.01	0.35	0.30	0.6	0.01	0.00
10th Percentile	18.2	0.239	0.32	3.66	4.44	-228.7	0.02	0.42	0.30	0.6	0.01	0.00
Median	20.2	0.491	0.64	7.10	5.24	-70.6	0.05	1.20	0.80	1.1	0.03	0.00
90th Percentile	20.9	0.740	1.80	19.56	5.75	56.8	0.14	4.13	1.26	3.4	0.03	0.00
Maximum	21.7	0.965	1.90	21.10	5.88	63.1	0.15	5.13	1.40	6.1	0.04	0.00
Average	19.84	0.513	0.91	9.94	5.21	-82.3	0.07	1.97	0.78	1.8	0.02	0.00
Standard Deviation	1.22	0.236	0.66	7.11	0.55	114.5	0.06	2.20	0.43	1.8	0.01	0.00



Appendix 2 ASS Self-Assessment Form (WAPC, 2020)

Acid Sulfate Soils Self-Assessment Form

Version: 6.1 (August 2020)

Applicant

The applicant is the person with whom the WAPC will correspond and, if the application is approved, the person to whom the approval will be sent.

WAPC

reference no.

Full name

Postal address

Town / suburb

Postcode

Email

Phone number

Applicant
signature

Date

Application
property details

Step 1

Assess the possibility of acid sulfate soils disturbance

Question 1: Are any dewatering or drainage works (either temporary or permanent) proposed to be undertaken?

yes

no

Question 2: Is excavation of 100 cubic metres or more of soil proposed?
(100 cubic metres is about 10 standard-sized dump truck loads.)

yes

no

If you have answered no to both question 1 and question 2 then no further investigation is required at this stage. Please sign this form and submit it, together with any supporting information, to the Department of Water and Environmental Regulation (DWER).

If you have answered yes to either question 1 or question 2 go on to step 2.

Step 2

Conduct an acid sulfate soils investigation in accordance with the guideline, *Identification and investigation of acid sulfate soils*, available on DWER's website at <https://dwer.wa.gov.au/>

Question 3: Did the acid sulfate soils investigation indicate that there are acid sulfate soils present?

___ yes

___ no

If no to question 3, then no further investigation is required at this stage. Please sign this form and submit it, together with the written results of the investigation (in the form of an acid sulfate soils report) and supporting information to DWER with a request for clearance of the acid sulfate soils condition.

If yes to question 3, please sign this form and submit it, together with the written results of the investigation (in the form of an acid sulfate soils report), an acid sulfate soils management plan and a copy of the approved subdivision plan, to DWER with a request for approval of the management plan.

Note: After completion of site works in accordance with the approved management plan you will be required to submit a closure report, prepared in accordance with DWER's acid sulfate soils guidelines, to DWER together with a request for clearance of the acid sulfate soils condition.

Tick box for attachments as appropriate

- ☐ copy of current deposited plan
- ☐ copy of approved subdivision plan
- ☐ copy of approved development plan
- ☐ acid sulfate soils investigation report
- ☐ acid sulfate soils management plan

Declaration

I declare that the information provided is true and correct to the best of my knowledge.

Applicant signature:

Date:

Submit form and required attachments to the
Department of Water and Environmental Regulation

By email: info@dwer.wa.gov.au

Or by mail:
Department of Water and Environmental Regulation
Locked Bag 10,
Joondalup DC, WA 6919

If you have any questions relating to the Acid Sulfate Soils Self-Assessment form,
please contact DWER on 1300 762 982 or email info@dwer.wa.gov.au



Appendix 3 Revegetation Methodology

Lot 28 (157 Barfield Road) Revegetation Methodology

Revegetation Areas

It is proposed to undertake revegetation works over a 0.72 hectare area within the easement adjacent to Lot 28.

The area proposed for earthworks will be revegetated by the proponent to the requirements of the City of Cockburn as a condition of subdivision approval for the residential development. These revegetation works must also comply with conditions imposed on revegetation within easements by Western Power.

Revegetation Strategy and Completion Criteria

Baseline Flora and Vegetation Data

The site is historically representative of Beard Vegetation Association 1001, which is described as 'medium very sparse woodland; Jarrah, with low woodland; Banksia or Casuarina' (Beard et al, 2005) and the Bassendean Complex – Central and South (Figure 6; Heddle et al, 1980). The Bassendean Complex – Central and south is described as "woodland of jarrah (*Eucalyptus marginata*), *Allocasuarina fraseriana*, *Banksia attenuata*, *B. grandis* and *B. menziesii* on the sand dunes to low woodland of *Melaleuca preissiana*, *B. ilicifolia* and *B. littoralis* and sedgelands on the low-lying moister sites. This area includes the transition of jarrah to coastal blackbutt (*E. tottiana*) in the Perth vicinity and jarrah to marri (*Corymbia calophylla*) on the moister soils. Other plant species include *Kunzea ericifolia*, *Hypocalymma angustifolium*, *Adenanthos obovatus* and *Verticordia* species (Heddle et al, 1980).

A detailed vegetation and flora survey was undertaken on the site (Coterra, 2017) in accordance with relevant government guidance (EPA, 2016a). Two vegetation types were observed on the site, as follows:

- An Open Low Forest of *Banksia attenuata*, *B. ilicifolia* and *B. menziesii* with scattered *Allocasuarina fraseriana* over Open Tall Shrubland to Tall Shrubland of *Xanthorrhoea preissii*, with occasional pockets of *Kunzea glabrescens* tall shrubs, over Open Shrubland to Shrubland of *Stirlingia latifolia* over Open Low Shrubland of *Hibbertia hypericoides* or *Hypocalymma robustum* and *Bossiaea eriocarpa* or over a mixed Sedgeland/Herbland including *Phlebocarya ciliata*, and/or *Desmocladius flexuosus* and *Lepidosperma squamatum* on midslope flats, on loamy sands, was recorded predominantly in the western portion of the subject area.
- Scattered *Banksia menziesii* and *B. ilicifolia* over Shrubland to tall Shrubland of *Adenanthos cygnorum* over Open Grassland of introduced species *Ehrharta calycina* with scattered native low shrubs, on midslope sandy flats was recorded predominantly in the eastern portion of the subject area.

Current Site Condition

The proposed revegetation area comprises vegetation in 'Completely Degraded' to 'Degraded' condition, representative of the 'Scattered Banksia Shrubland, detailed above. The proposed revegetation area is not representative of Banksia Woodland.



Plate 1: Vegetation and weed presence



Plate 2: Typical vegetation within easement

Revegetation Methodology

The proposed revegetation methodology will generally comprise the following:

Clearing and Topsoil Removal

Clearing will be undertaken within the easement to facilitate development on Lot 28.

Clearing activities will be undertaken in accordance with engineering requirements for the site.

Topsoil will be removed and stored on site, for re-use in revegetation areas. It should be noted that topsoil may produce native germinates that grow above the 2 m height limitation, and as such, these may need to be destroyed (pers. comm James Lawton, 7 December 2021).

Slope and Surface Stabilisation

Slope and surface stabilisation will be conducted using either of the following:

- collection of in-situ (cleared and felled) mulched vegetation will be undertaken prior to earthworks on the site
- installation of coir netting, if required
- application of a dust suppression product (such as Gluon).

The actual methodology may involve a combination of the above techniques. These actions will be undertaken after clearing.

Species Selection

In accordance with the Transmission Easement Notice, no vegetation exceeding 1 m in height from the natural surface of the land should be grown, cultivated or maintained within the easement (Western Power, undated).

A proposed revegetation species list is provided based on vegetation historically recorded on the site, Western Power requirements for revegetation within easements, and Black Cockatoo foraging opportunities (Appendix 1).

Site Preparation

Soils within the revegetation area will be ripped to 500 mm prior to planting, if possible, depending on slope. If the site has steep batters, ripping may not be possible in these locations, and alternative methods for site preparation will be implemented.

Planting Techniques

Tubestock planting will be undertaken at a rate of 1.6 plants/m².

Tubestock will be sourced from accredited Dieback-free local nurseries. Where possible, local provenance material (within 50 km of the site) will be used.

Where revegetation areas cannot be fenced (below), corflute tree guards will be installed after planting. Tree guards will be removed in the first summer after planting, only if it is determined that the rabbit population will not severely impact planting (pers. comm James Lawton, 7 December 2021).

Weed Control

It is proposed that weed control works be undertaken in areas of retained vegetation to improve the quality and condition of vegetation. Weed control works will be implemented in all areas of retained vegetation as follows pre- and post-planting.

Pre-planting weed control will comprise:

- initial spot-spraying of broad spectrum herbicide application (i.e. Glyphosate) in autumn, 2-4 weeks prior to winter planting.

Post-planting weed control will comprise:

- spot-spraying of broad spectrum herbicide application (i.e. Glyphosate) in late winter/spring following planting to allow for additional removal of weeds prior to flowering and seed propagation
- broad spectrum herbicide application (i.e. Glyphosate) in summer, to coincide with summer active weeds
- annual winter/spring broad spectrum herbicide application (i.e. Glyphosate), as required
- annual summer broad spectrum herbicide application (i.e. Glyphosate), as required.

Access and Fencing

Suitable fencing (1.2 m high with rabbit netting) will be installed around revegetation areas to manage inadvertent access to the areas. In accordance with the Transmission Easement Notice, this fence must be earthed to the satisfaction of Electricity Networks Corporation in the case of a metallic fence or trellis (Western Power, undated). Fencing will not be installed to the detriment of access to Western Power infrastructure.

Signage

Signage will be installed adjacent to revegetation areas to advise “No Entry – Revegetation Area”.

Completion Criteria

Completion criteria for the revegetation areas has been determined on the basis of revegetation guidelines developed by the neighbouring City of Cockburn (2017; Table 1).

Table 1: Success Criteria for Revegetation Works

Assessment Parameter	Method	Completion Criteria
Seedling survival	5 m x 5 m quadrats Photo points/monitoring	1.6 plants/m ² for dryland species
Species representation	5 m x 5 m quadrats/transects Photo points/monitoring	75% of dryland species
Weed cover	5 m x 5 m quadrats Photo points/monitoring	5%
Declared weeds	5 m x 5 m quadrats Photo points/monitoring	No declared weeds to be present.

Note: The completion criteria will be assessed via averaging the results from the monitoring locations.

Monitoring and Reporting

Monitoring will be undertaken to assess weed cover and plant survival rates within the revegetation area against completion criteria (Table 1). These monitoring events will occur annually commencing in:

- autumn following the year that planting was undertaken, to measure plant survival. This will inform the need for any infill planting for the upcoming winter
- spring to measure to measure plant density/success.

5 m x 5 m quadrats and photo points will be established within each revegetation area, to allow for consistency of monitoring over time. Exact locations of these quadrats and photo point locations will be provided in the first monitoring report prepared for the revegetation program.

Monitoring is to be ongoing for at least 2 years post-revegetation and shall continue until completion criteria have been met. Monitoring will also make note and include photos of any signs of erosion or storm damage to revegetation areas to enable appropriate management measures.

Once initial revegetation actions have been completed, a report will be prepared and submitted to the City of Cockburn within 30 days.

Thereafter, revegetation monitoring reports, comprising results of revegetation works, monitoring results for autumn and spring and any contingency actions that were implemented, will be prepared, and submitted to the City of Cockburn on an annual basis, and within 30 days after the completion of Spring monitoring events.

Contingency Actions

If monitoring indicates that the success criteria are not being met, contingency actions may be undertaken:

- infill planting (30% infill after Year 1 monitoring, then 15% infill after Year 2 monitoring) to increase plant numbers, plant species, ground coverage and / or replace damaged or dead seedlings
- additional broad spectrum herbicide application, or manual weed control to reduce weed coverage, as required, in winter, spring and autumn
- installation of additional corflute tree guards for protection to exclude pests.

References

City of Cockburn (2017). *Guidelines for Revegetation and Maintenance of Natural Bushland/Wetland Areas*. City of Cockburn, Perth, Western Australia.

Western Power (undated). *Transmission Easement Notice*. Western Power, Perth, Western Australia.

Proposed Vegetation Species List within Easement (up to 2 m in height)

Species	Growth Form	Approximate Height (m)
<i>Allocasuarina humilis</i>	Shrub	0.2-2
<i>Anigozanthos manglesii</i>	Herb / groundcover	0.2-1.1
<i>Astartea scoparia</i>		1.8
<i>Atriplex cinerea</i>		0.2-1.5
<i>Beaufortia elegans</i>		0.3-1
<i>Bossiaea eriocarpa</i>		0.2-1
<i>Calothamnus quadrifidus</i> 'Little Ripper'		0.2-0.4
<i>Conostylis aculeata</i>	Herb / groundcover	0.06-0.5
<i>Conostylis candicans</i>		0.05-0.4
<i>Daviesia physodes</i>	Shrub	0.4-1.8
<i>Dianella revoluta</i> var <i>divaricata</i>	Herb / groundcover	0.3-1.5
<i>Ficinia nodosa</i>		Up to 1
<i>Gastrolobium capitatum</i>	Shrub	to 1
<i>Grevillea crithmifolia</i> 'Green Carpet'		0.6-0.8
<i>Hemiandra pungens</i>		0.05-1
<i>Hibbertia hypericoides</i>		0.2-1.5
<i>Hovea pungens</i>	Shrub	0.2-1.8
<i>Hypocalymma angustifolium</i>	Shrub	to 1.5
<i>Hypocalymma robustum</i>		0.4-1.5
<i>Kennedia prostrata</i>	Herb / groundcover	0.1
<i>Melaleuca huegelii</i> Prostrate		0.2
<i>Melaleuca seriata</i>	Shrub	0.25-1
<i>Patersonia occidentalis</i>	Herb / groundcover	1.5
<i>Pultenaea reticulata</i>	Shrub	0.5-2
<i>Regelia ciliata</i>	Shrub	0.8-2
<i>Verticordia densiflora</i>	Shrub	0.25-2
<i>Verticordia plumosa</i>		0.2-1.5
<i>Xanthorrhoea preissii</i>	Grass Tree	2

Source: Coterra, 2017; City of Cockburn, undated (<https://www.cockburn.wa.gov.au/Street-Trees-Pruning-and-Planting>); Tranen (pers. comm J. Lawton, 2 December, 2021).

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